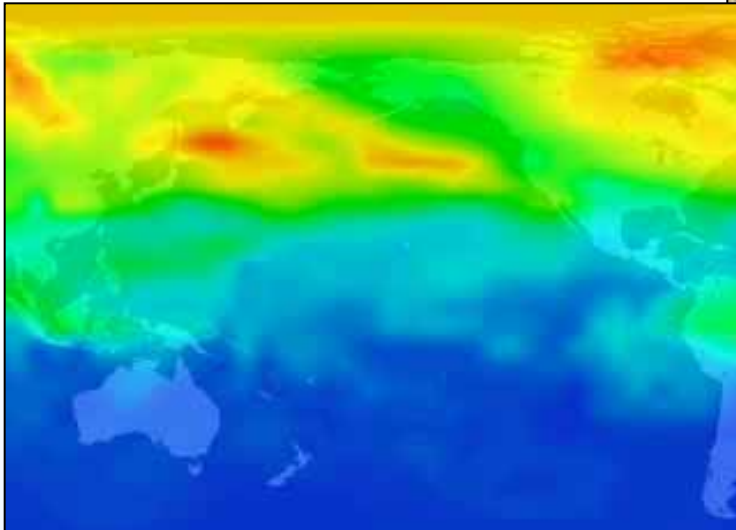




# Clearing the Air: Livestock's Contributions to Climate Change

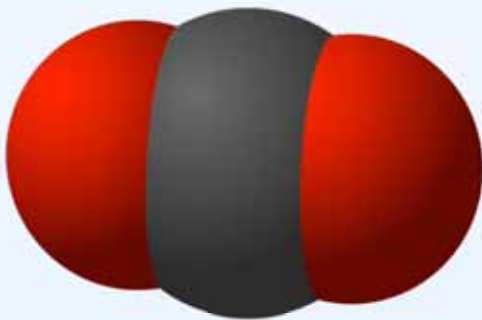


***Frank Mitloehner, PhD***  
*Assoc Prof & UC CE Specialist*  
Animal Science, UC Davis

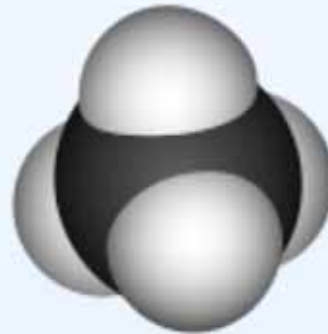
# GHG & GWP

## Global Warming Potential (GWP) of Main GHG

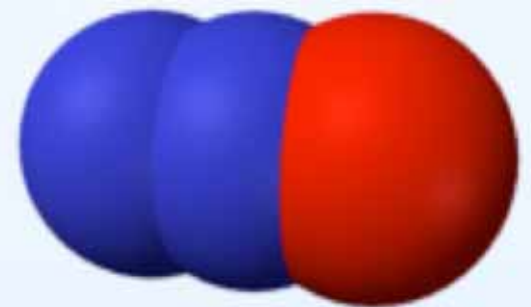
- Carbon Dioxide, CO<sub>2</sub> 1
- Methane, CH<sub>4</sub> 21
- Nitrous Oxide, N<sub>2</sub>O 310



CO<sub>2</sub> – Carbon Dioxide



CH<sub>4</sub> – Methane



N<sub>2</sub>O – Nitrous Oxide

# Livestock's Long Shadow (FAO, 2006)

LLS predictions are global not regional

- 18% of all anthropogenic GHG from livestock
- 9% of all carbon dioxide ( $\text{CO}_2$ )
- 40% of all methane ( $\text{CH}_4$ )
- 65% of all nitrous oxide ( $\text{N}_2\text{O}$ )



# “Livestock’s Long Shadow” predictions and its misinterpretations

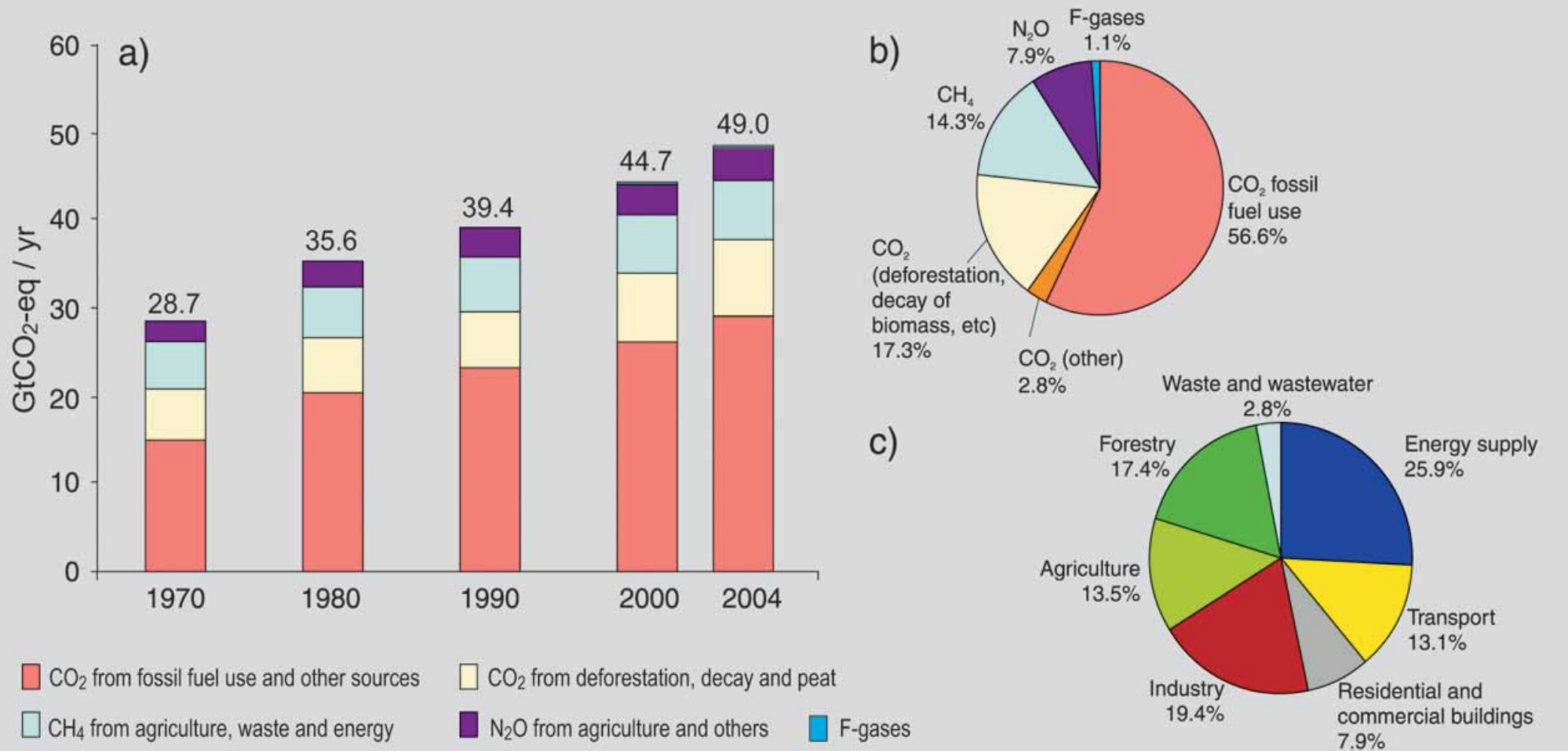
- “The Livestock sector is a major player, responsible for 18% of GHG emissions measured in CO<sub>2</sub>e. This is a higher share than transport” (FAO 2006)
- “Which is responsible for more global warming: your BMW or your Big Mac? Believe it or not, it’s your Big Mac” (Time, 2007)
- “A 16 oz T-bone is like a hummer on a plate. Switching to vegetarianism can shrink your carbon footprint by 1.5 tons of CO<sub>2</sub>e per year” (Time, 2007)

## Sources of GHG from Ag

- Enteric fermentation ( $\text{CH}_4$ )
- Land application of manure ( $\text{N}_2\text{O}$ )
- Manure storage and treatment ( $\text{CH}_4$  and  $\text{N}_2\text{O}$ )
  
- Leading  $\text{CH}_4$  source is enteric fermentation from ruminants
- Leading  $\text{N}_2\text{O}$  source is land incorporated manure and fertilizer



# Global big picture

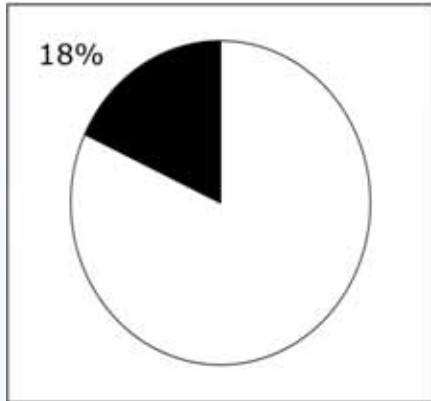


Source: IPCC 4AR, 2004

# Reports summarized

## UN-FAO:

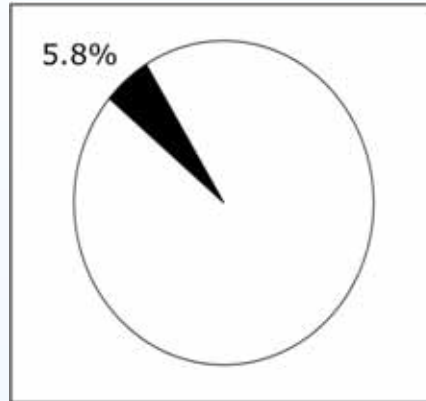
Livestock's Long Shadow (LLS)



Livestock as portion of emissions  
 $\sim 7,100 \text{ Tg CO}_2\text{-eq yr}^{-1}$

## US-EPA:

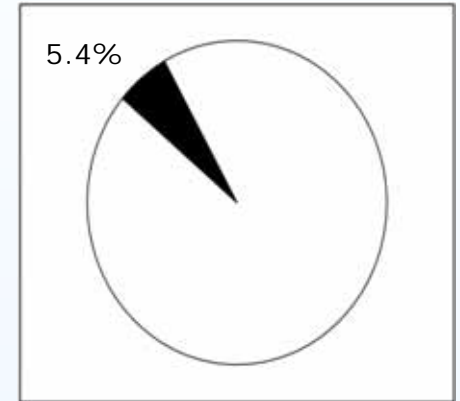
Inventory of U.S. Greenhouse Gas Emissions and Sinks



Agriculture as portion of emissions  
 $414 \text{ Tg CO}_2\text{-eq yr}^{-1}$

## CEC:

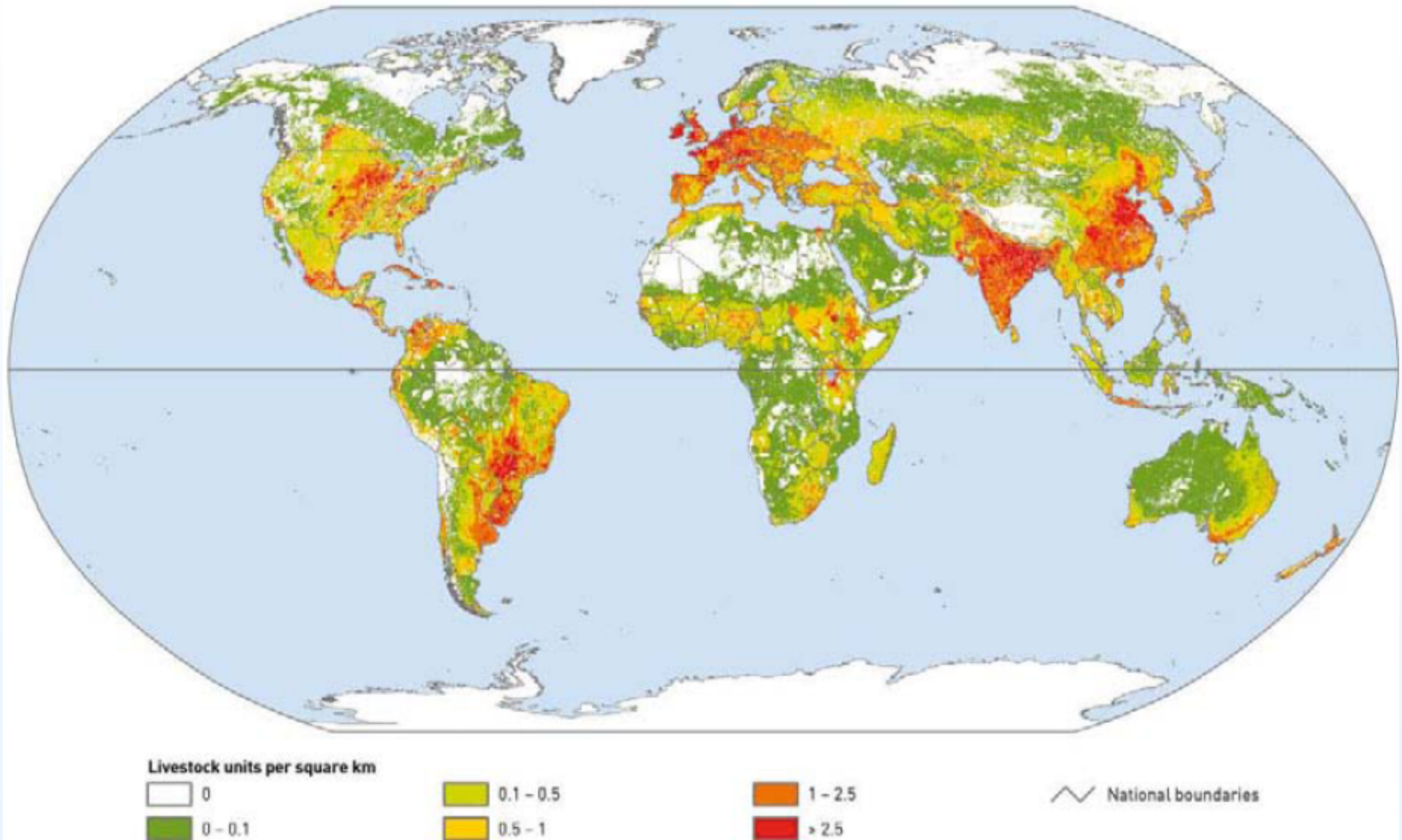
California GHG Inventory



Agriculture as portion of emissions  
 $27 \text{ Tg CO}_2\text{-eq yr}^{-1}$

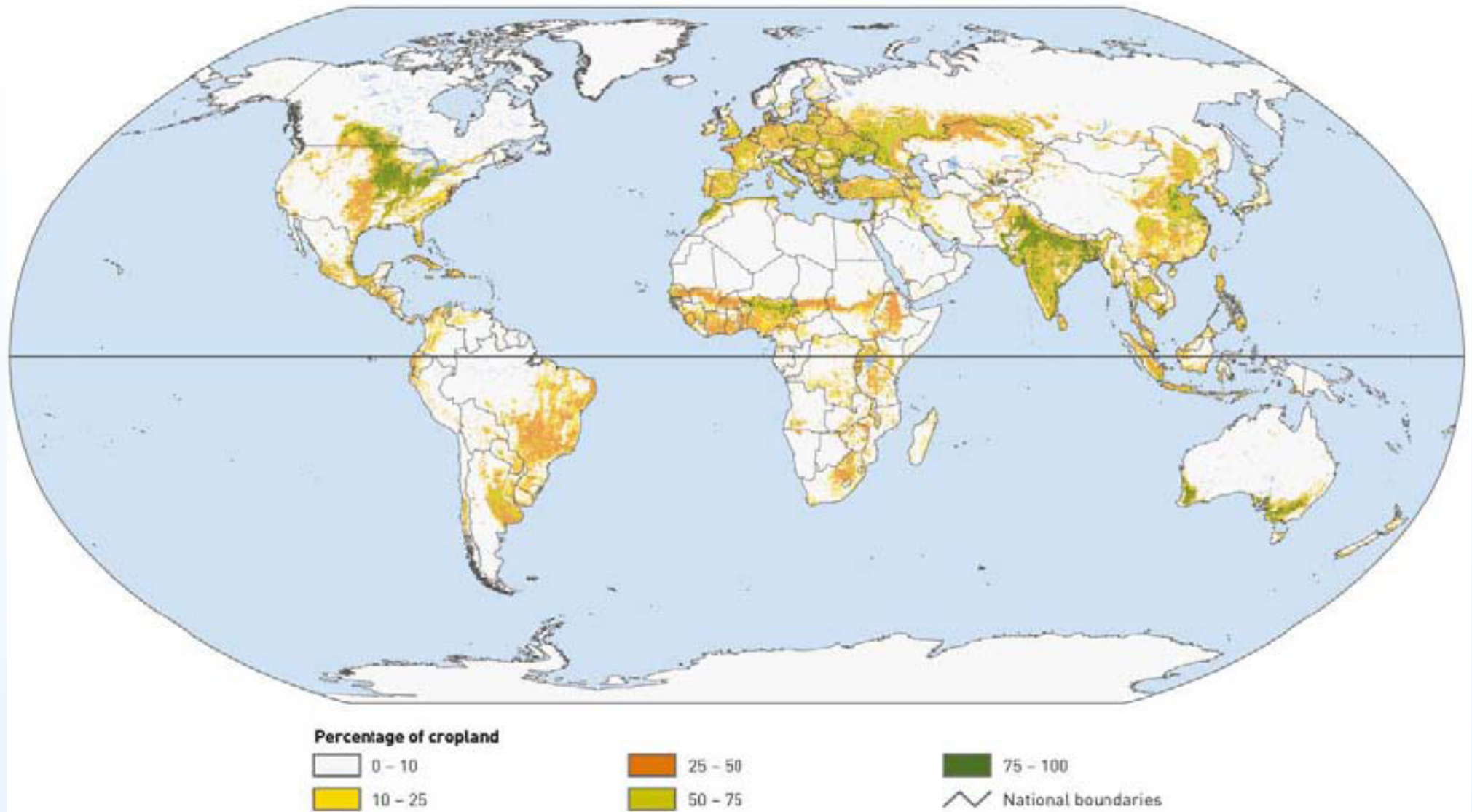
If true, livestock is a greater source of GHGs than the transportation sector (FAO, 2006)

# Global livestock distribution



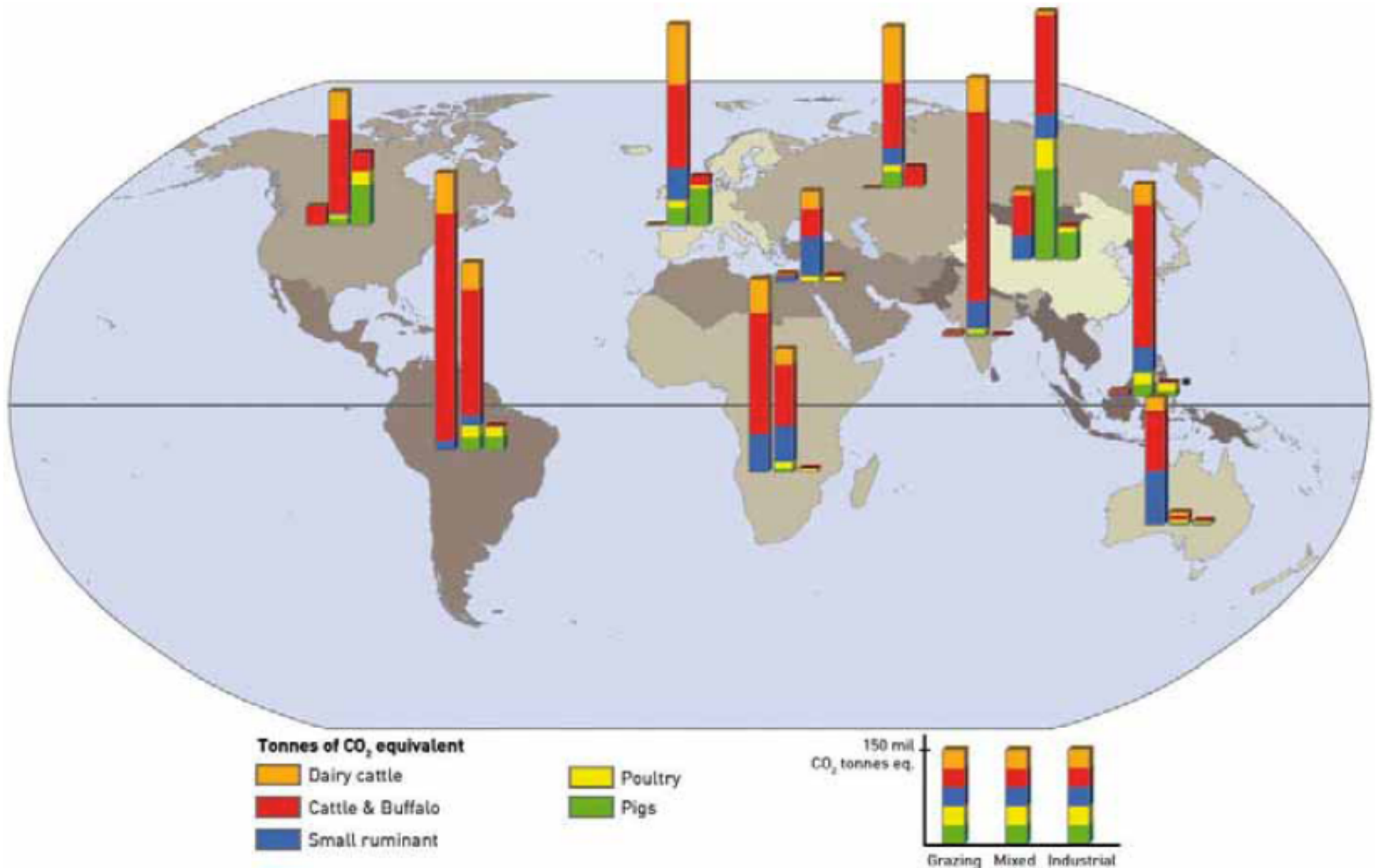


# Distribution of cropland

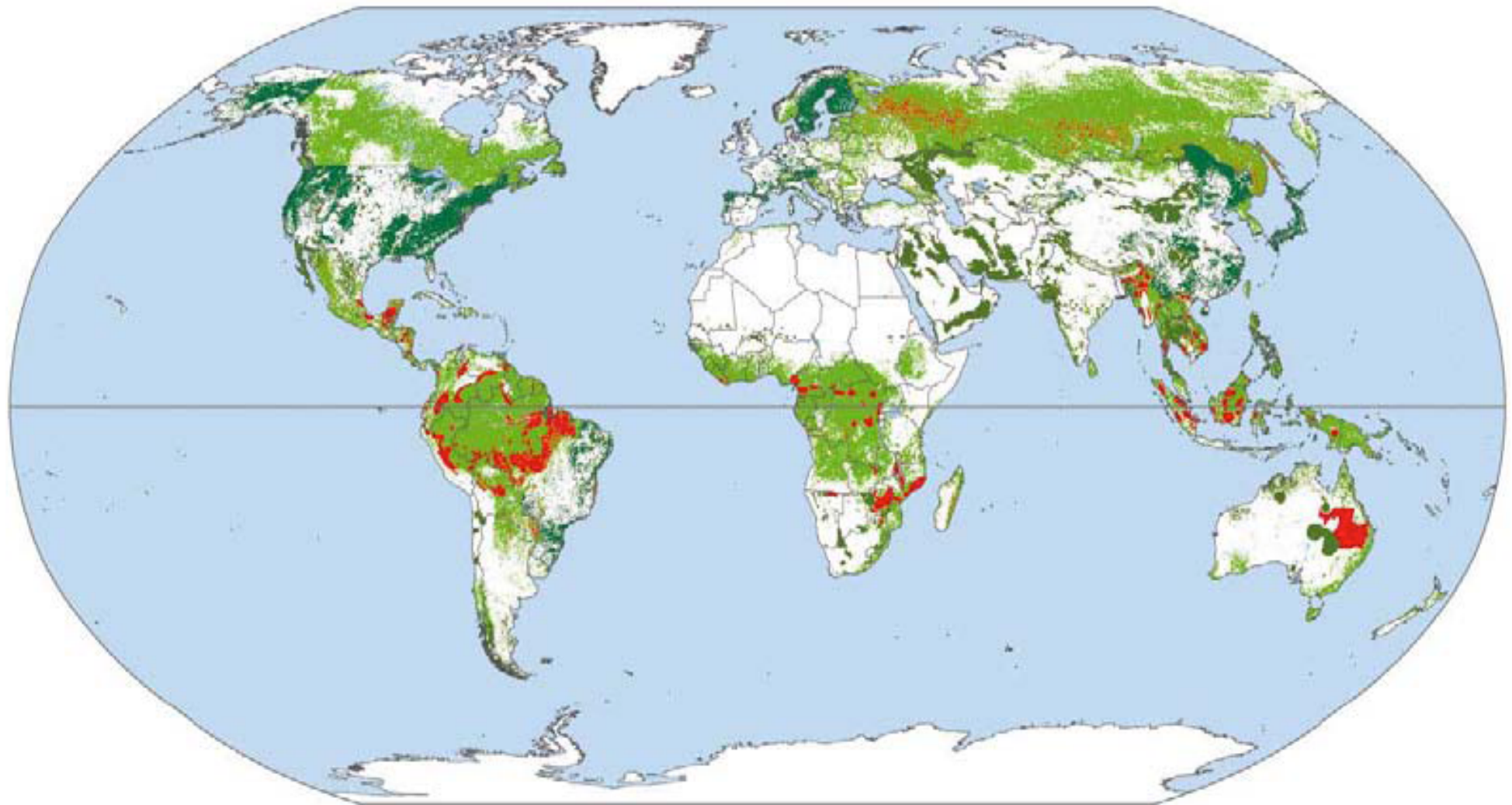


Source: FAO, 2006f.

# Total GHG emissions from enteric fermentation and manure per species and main production system



# Forest transition and land degradation in dry lands



Source: FAO, 2006

Land degradation in drylands  
Net loss of forest

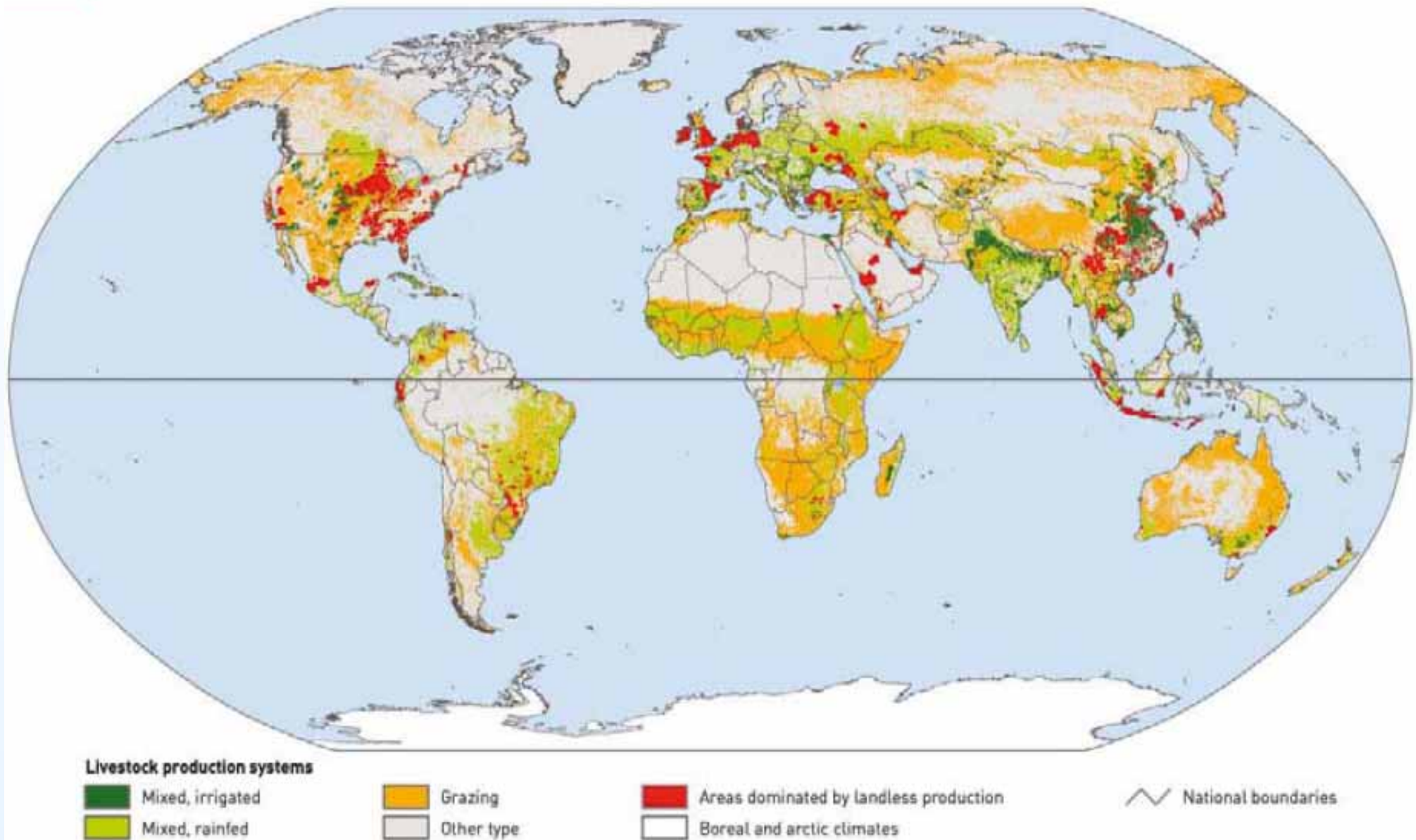
Current forest cover  
Net gain of forest

National boundaries

Deforestation in the amazon for livestock production accounts for ~1/3 of the total GHG due to livestock

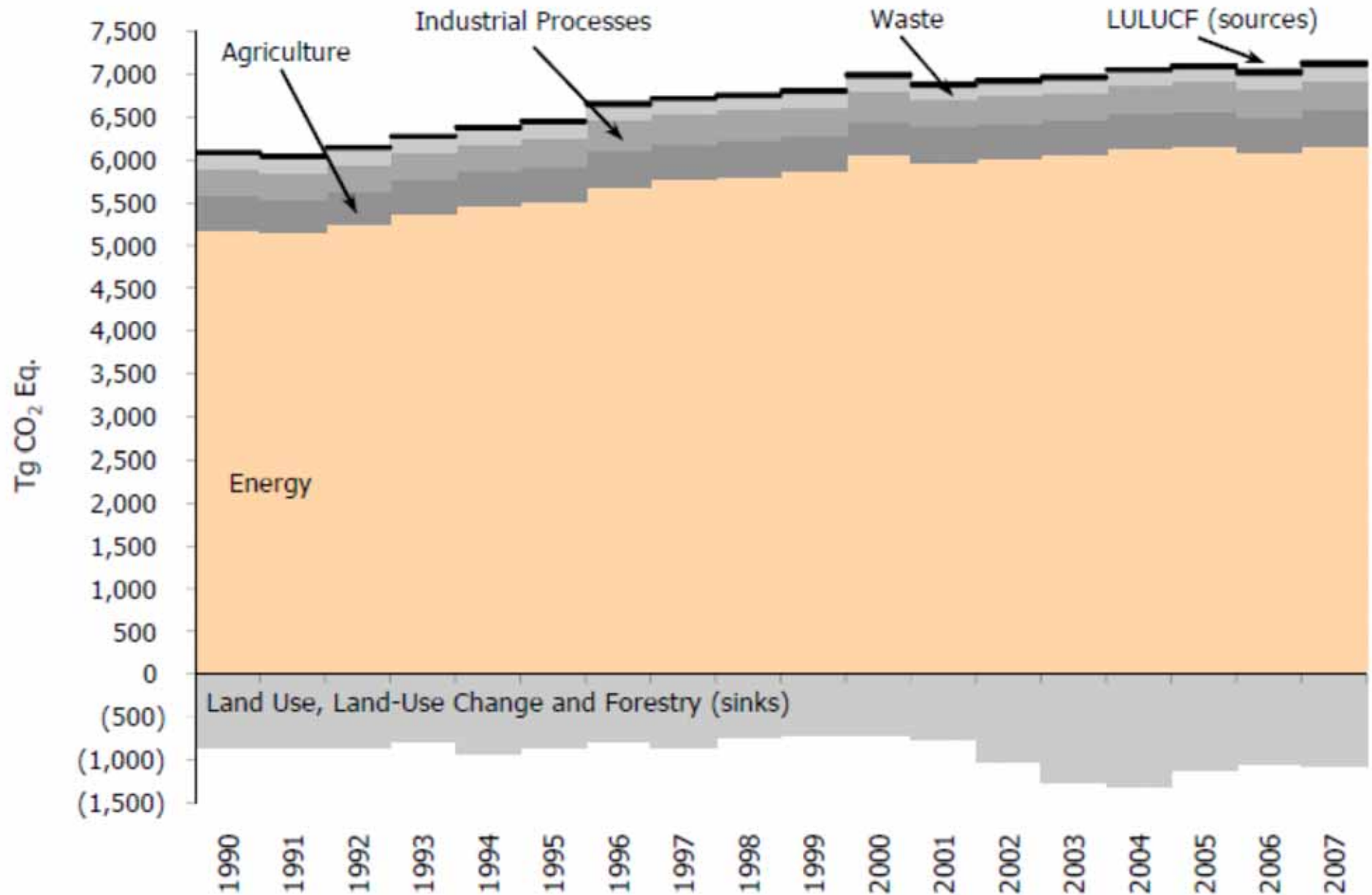


# Livestock Production Systems and land-use change



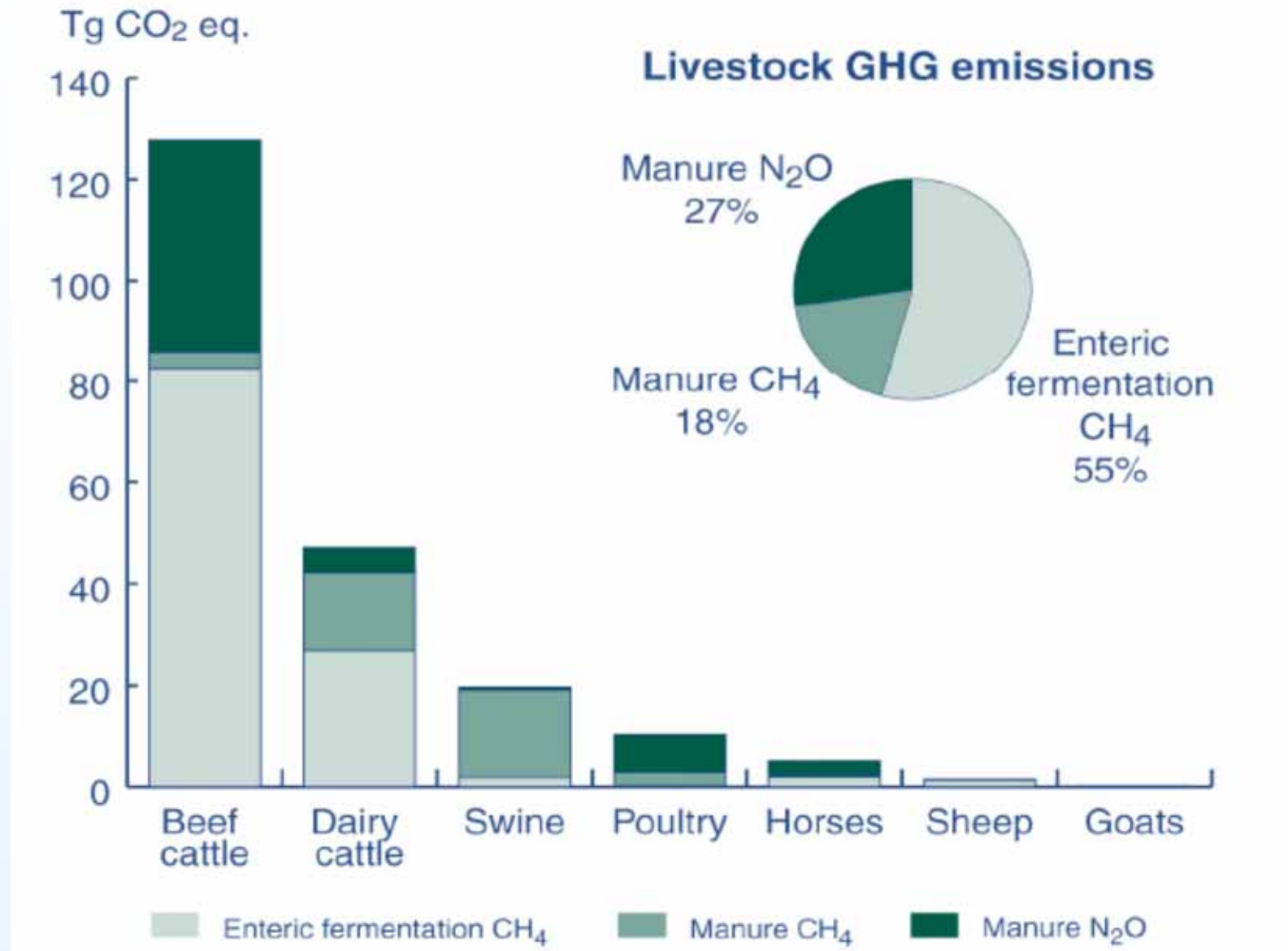
Extensive vs. intensive

# U.S. – the big GHG picture

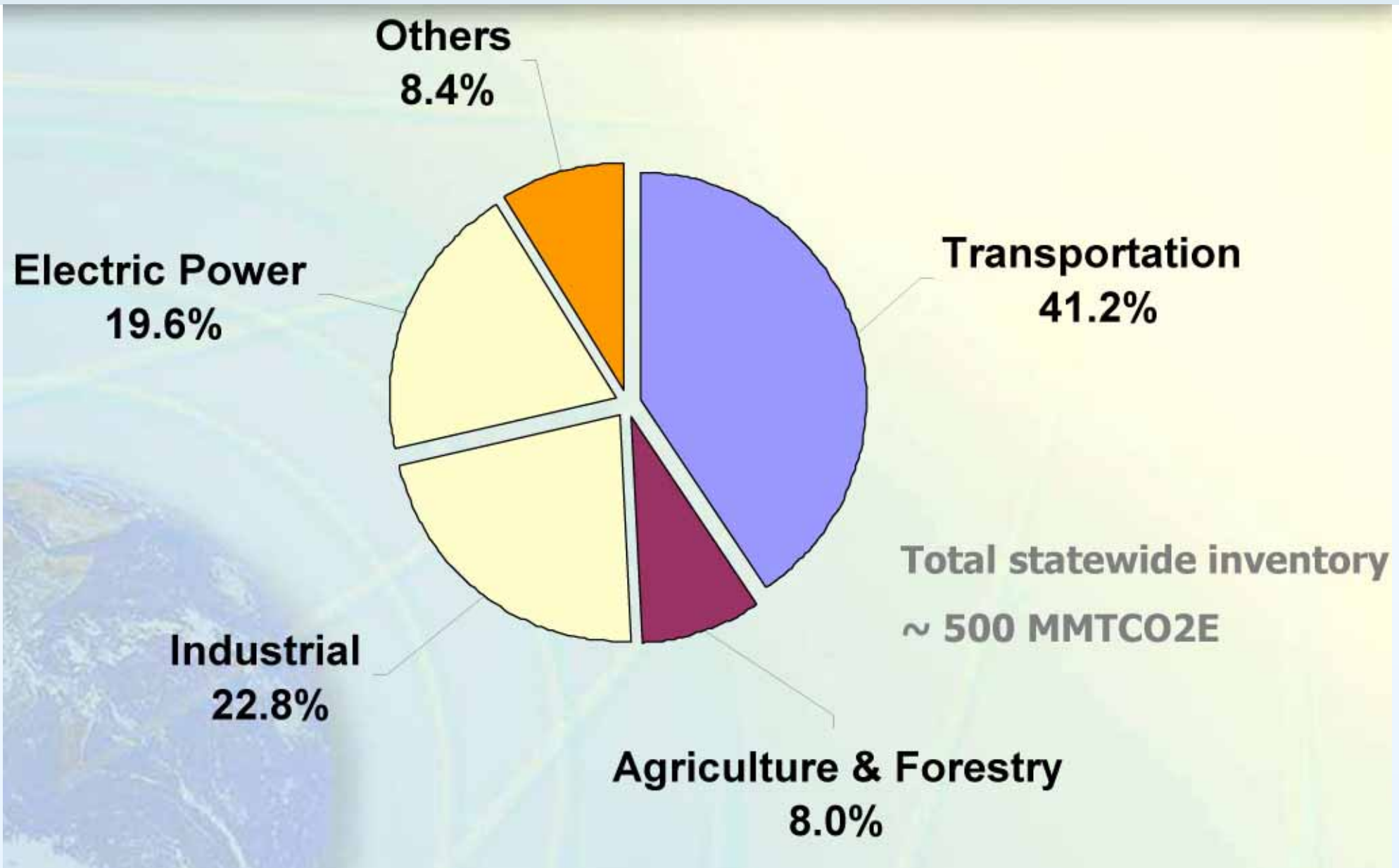




# US GHG emissions from livestock



# California GHG inventory



# California GHG inventory

- All GHG sources in California = 500 MMT CO<sub>2</sub>e
- Transport = 190 MMT CO<sub>2</sub>e
- Energy industry = 170 MMT CO<sub>2</sub>e
- Agriculture (all sectors) = 27 MMT CO<sub>2</sub>e
- Dairy (enteric and waste) = 11.2 MMT CO<sub>2</sub>e

# Livestock emissions - enteric fermentation

## UN-FAO:

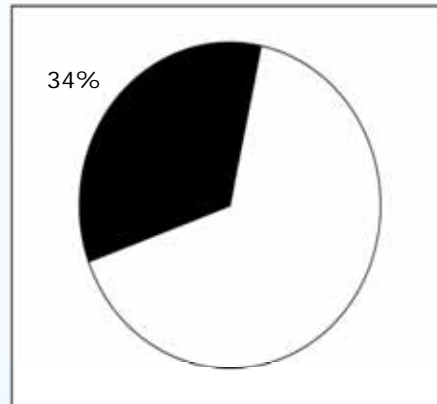
Livestock's Long  
Shadow (LLS)



1,800 Tg CO<sub>2</sub>-eq yr<sup>-1</sup>

## US-EPA:

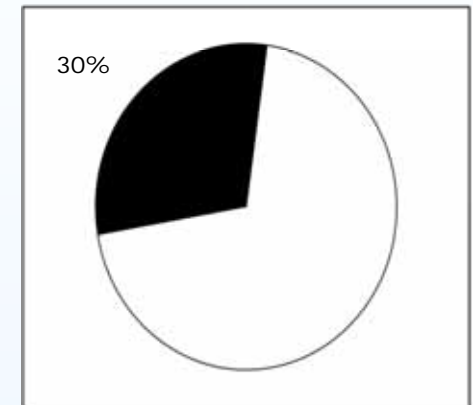
Inventory of U.S.  
Greenhouse Gas Emissions  
and Sinks



139 Tg CO<sub>2</sub>-eq yr<sup>-1</sup>

## CEC:

California GHG  
Inventory

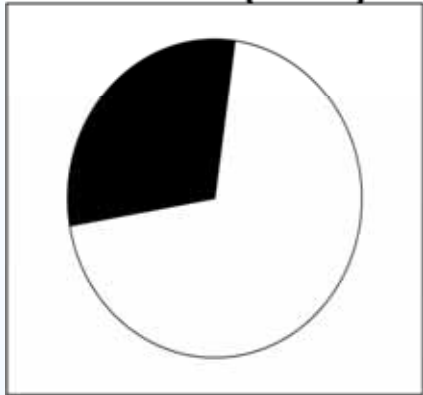


7 Tg CO<sub>2</sub>-eq yr<sup>-1</sup>

# Livestock emissions – animal manure

## UN-FAO:

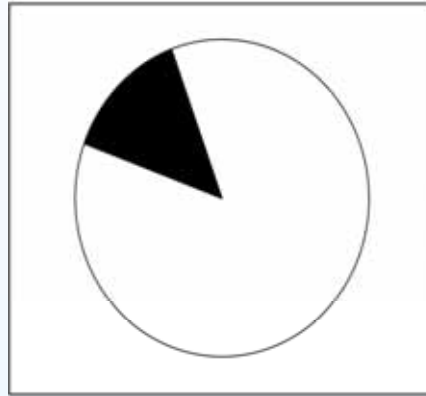
Livestock's Long Shadow (LLS)



1800 Tg CO<sub>2</sub>-eq yr<sup>-1</sup>

## US-EPA:

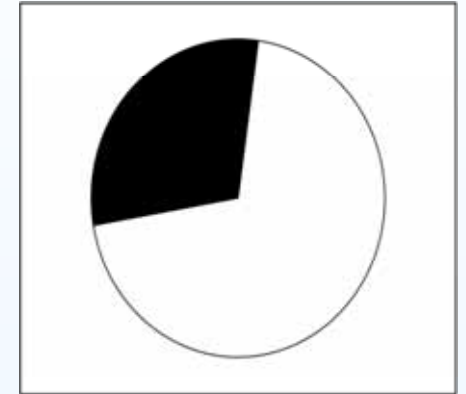
Inventory of U.S. Greenhouse Gas Emissions and Sinks



59 Tg CO<sub>2</sub>-eq yr<sup>-1</sup>

## CEC:

California GHG Inventory



7 Tg CO<sub>2</sub>-eq yr<sup>-1</sup>

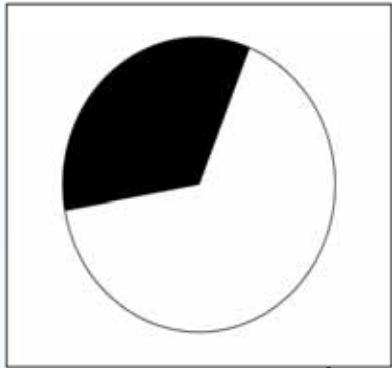




# Livestock emissions land-use change

## UN-FAO:

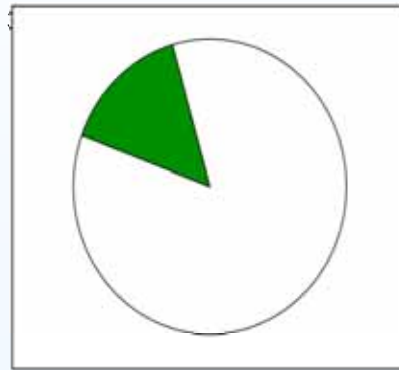
Livestock's Long  
Shadow (LLS)



2,400 Tg CO<sub>2</sub>-eq yr<sup>-1</sup>

## US-EPA:

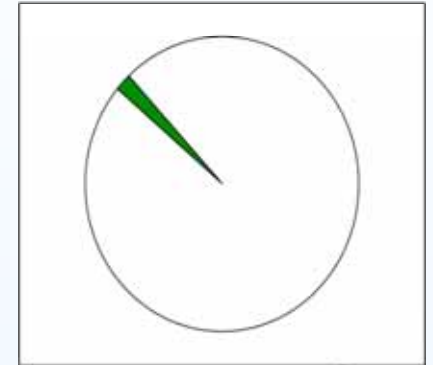
Inventory of U.S.  
Greenhouse Gas Emissions  
and Sinks



(1,078) Tg CO<sub>2</sub>-eq yr<sup>-1</sup>

## CEC:

California GHG  
Inventory



(5) Tg CO<sub>2</sub>-eq yr<sup>-1</sup>

Net sequestration of agricultural land and  
forest land









# **Clearing the Air: Livestock's Contributions to Climate Change**

Maurice Pitesky, Kim Stackhouse,  
and Frank Mitloehner

*Advances in Agronomy*, Vol 103



# Conclusions

- Global meat production will double by 2050 (mainly developing world)
- Growth will occur in areas that are currently forested
- Livestock in developed countries has relatively small GHG contribution dwarfed by large transportation, energy, and industry
- In developing countries livestock can be a dominant contributor to the GHG portfolio due deforestation and to their relatively smaller transportation and energy sectors

# Conclusions

- According to *Livestock's Long Shadow*, intensification provides “large opportunities for climate change mitigation, can reduce greenhouse gas emissions from deforestation,” and is the long-term solution to more sustainable livestock production
- In the United States, transportation accounts for at least 26% of total anthropogenic GHG emissions compared to roughly 6-8% for all of agriculture, which includes less than 3% associated with livestock production

# Conclusion

- The significant change that affects carbon levels in the United States is the conversion of agricultural lands to development, which reduces land available for carbon sequestration

